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ABSTRACT

Tests for four letter-sound generalizations--"c" pronounced as [k] or [s] and "a" pronounced as [ae] or [e]--were given to 73 first, second, and third grade children at six-week intervals during a single school year. Each test included five synthetic words (e.g., cipe, acim, bice, cib, ocet) for each generalization. Children responded individually to the test items by attempting to pronounce each one aloud. The long and short pronunciations of "a" ([e] and [ae]) and the [k] pronunciation of "c" were learned to a high degree of accuracy. They showed no significant differences across grade levels, but did differ significantly across ability groups. For "c" pronounced as [s], however, learning was extremely low at all grade levels and reached only 45% correct by the end of grade 3. Initial "c" as [s] was learned more slowly than medial "c" as [s], indicating an interaction between letter pattern and word position. The failure to acquire the "c" pronounced as [s] pattern, especially in word-initial position, appears to result primarily from the failure of most beginning reading texts to include a sufficient sampling of words which begin with "c" before "e," "i," or "y." (Author/HS)

Technical Report No. 189

THE DEVELOPMENT OF TWO LETTER-SOUND PATTERNS IN GRADES 1-3

by Richard L. Venezky and Dale Johnson

Report from the Project on Basic Prereading Skills

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Statement of Focus

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Basic Prereading Skills Project, an element of the Reading and Related Language Arts Project in Program 2, Processes and Programs of Instruction. General objectives of the Program are to develop curriculum materials for elementary and preschool children, to develop related instructional procedures, and to test and refine the instructional programs incorporating the curriculum materials and instructional procedures. Contributing to these program objectives, this element has two general objectives: (1) to investigate ways to test for skill deficits and to overcome them and (2) to develop a kindergarten-level program, including diagnostic tests and instructional procedures, for teaching basic prereading skills. Tests and instructional programs will be developed for visual and auditory skills including letter and letter-string matching with attention to order, orientation and detail, and speech sound matching and blending.

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Abstract

Tests for four letter-sound generalizations, c→[k], c→[s], a→[æ], and a→[e], were given to 73 first, second, and third grade children at six-week intervals during a single school year. Each test included five synthetic words (e.g., cipe, acim, bice, cib, ocet) for each generalization. Children responded individually to the test items by attempting to pronounce each one aloud. The long and short pronunciations of a ([e] and [æ]) and the [k] pronunciation of c were learned to a high degree of accuracy and showed no significant differences across grade levels, but did differ significantly across ability groups, which were defined by scores on a standard reading test administered at the end of the school year. For c→[s], however, learning was extremely low at all grade levels and reached only 45% correct by the end of grade 3. Initial c→[s] was learned more slowly than medial c→[s], indicating an interaction between letter pattern and word position. The failure to acquire the c→[s] pattern, especially in word-initial position, appears to result primarily from the failure of most beginning reading texts to include a sufficient sampling of words which begin with c before e, i, or y.

I
Introduction

The effectiveness of primary school reading programs is usually assayed with standard reading tests which yield either a single overall score for reading ability or a small number of scores for such general categories as comprehension, vocabulary, and phonics abilities. But reading programs are seldom all good or all bad; each probably can be shown to do something as well as or better than all other programs, and to do something as poorly or worse than the others. Furthermore, a teacher who wants to improve her teaching of reading receives little applicable feedback from such gross evaluations. Faced with an unacceptably low class average in comprehension, for example, a teacher has a limited number of options. She can continue with her present program, using her informal assessment of class progress to indicate where changes are required in methods or materials, or she can (in some school systems) select a new program, about which she will probably have considerably less detailed information than she does about her present program.

The kinds of information which a teacher needs to improve her teaching of reading are much more detailed than what standard reading tests now attend to. For example, to improve the teaching of letter-sound correspondences, a teacher needs to know, for each pattern she is teaching, how well each child is acquiring the pattern and whether errors on the pattern reflect a deficit on that particular pattern or on a more general skill, such as ability to attend to letters in the middle of a word. A single "word attack" score has little diagnostic value in this situation, especially for those children who fall in the middle ranges between complete mastery and complete failure.

As a step towards providing detailed diagnostic data for teaching reading, a diagnostic test for two letter-sound patterns was developed and tested on primary school children.

II
Method

Subjects

The subjects were 24 first, 24 second, and 25 third grade pupils from a public school in Stoughton, Wisconsin, a small city of 6,000 population in the south-central portion of the state. All of these students had been or were being taught in grade 1 with either a phonics program or with a tri-basal approach with a heavy supplementary dose of phonics instruction.

Procedure and Stimulus Items

All Ss were tested on letter-sound translation ability at six-week intervals, and then during the last month of school were tested on vocabulary and comprehension using the Gates-MacGinitie Reading Test. Ss in grades 2 and 3 were tested four times during the school year, beginning in November; Ss in grade 1 were tested three times, starting in January. All testing was conducted during the 1970-71 school year and was done by an advanced graduate student in education with seven years' experience as a first grade teacher. The spelling-sound translation tests each contained 20 synthetic words which were presented one at a time on flash cards; the subject responded by reading the word aloud. Two orders were selected for each list and randomly assigned to Ss. In all lists, words were constructed for two major spelling-sound patterns: (a) c pronounced [s] or [k] according to the following letter,[1] and (b) a pronounced [æ] or [e] according to the free-checked (long-short) environments (see Venezky, 1970, pp. 100 ff.). These patterns were selected on the basis of tests by Calfee, Venezky, and Chapman (1969) and Venezky, Chapman, and Calfee (1971) which showed strikingly different learning patterns for the c and a correspondences, although they are theoretically quite similar.

For each of the four correspondences, c→[s], c→[k], a→[æ], a→[e], hereafter called patterns, five synthetic words were selected randomly for each test from a word pool constructed using spelling patterns found in real English words, but rejecting any item which had a plausible pronunciation which was a real English word.[2] All three grades responded to the same list of synthetic words at each test period except the first. However, as stated earlier, the lists varied from one time period to the next.

Pronunciation of the test letter (c or a) in each word was scored during the test session by the experimenter. (Tape recording of responses was abandoned after a pilot study showed a negligible increase in accuracy from such cross-checking.) Responses were either correct, plausible, or incorrect. The last category included not only wild responses such as [naIp] to cipe, but also correct letter responses when the response word itself was otherwise unrelated to the stimulus, e.g., [sauθ] for cep.

Subjects, who were tested individually in a quiet room, were told that they were to read some words that they probably knew and some other words that they probably did not know. Subjects were allowed 10 seconds to respond to each word. Total test time for each subject was never longer than 10 minutes.

[1] IPA transcriptions are used throughout this report.

[2] Where a→[æ] is expected, [e] is the plausible pronunciation; for a→[e], [æ]; for c→[s], [k]; and for c→[k], [s].

III
Results

Children within each grade were assigned to one of three reading ability groups (high, middle, low) according to scores on the Gates-MacGinitie Comprehension Test. A 3 x 3 analysis of variance (Grade by Ability Group) was then performed for each of the last three test periods with repeated measures on the last factor. For c→[k] there was a significant main effect for ability group at each test period (see Table 1) but not for grade nor for the interaction of grade with ability. For c→[s]

Table 1

Analysis of Variance for c→[k]: Ability Effect

Test Period	df	MS	F
2	62	23.54	17.79**
3	61	12.69	11.65**
4	62	11.65	11.65**

**p<.01

there was a significant main effect for grade at each test period (see Table 2) but not for

Table 2

Analysis of Variance for c→[s]: Grade Effect

Test Period	df	MS	F
2	62	4.67	24.14**
3	61	3.80	17.61**
4	62	2.92	15.57**

**p<.01

ability except at test period 4 ($F = 5.46$; df = 2/62; $p<.01$), and not for the interaction of grade and ability.

For the combined long-short patterns there was a significant main effect for ability at each test period (see Table 3),

Table 3

Analysis of Variance for Long and Short a: Ability Effect

Test Period	df	MS	F
2	62	80.05	14.35**
3	61	53.85	9.82**
4	62	85.34	15.09**

**p<.01

but not for grade nor the interaction of grade and ability. The difference between the long and short patterns showed a significant main effect for grade at test period 2 ($F = 7.59$; df = 2/62; $p<.01$), but there were no other significant effects or interactions.

In Figure 1 the percentage correct for each pattern is plotted for the last testing period of each grade. The long and short a patterns shared a common trend with insignificant differences in percentage correct at each test period. The c patterns, in contrast, were markedly different; the [k] pattern began at 85% correct and never deviated significantly from this level, while the [s] pattern began at 10% correct at the end of grade 1 and reached only about 45% correct by the end of grade 3.

The performances of students with varying abilities in reading on the four patterns are shown in Figures 2 and 3.

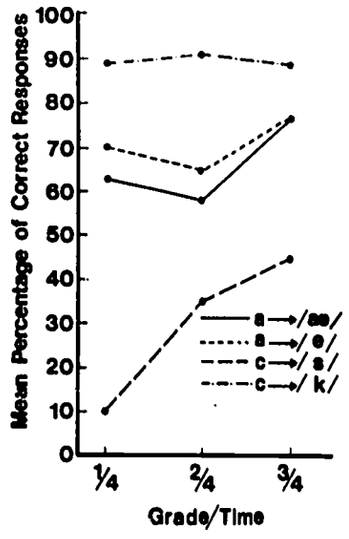

Figure 1 Correct responses to c and a patterns at time period 4.

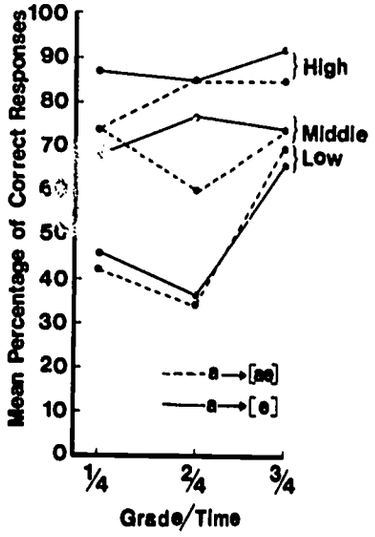

Figure 2 Correct responses to a patterns by ability group.

Once again the c and a patterns differed markedly, especially in the performance of the low ability group. For the c pattern, there was a large difference between grade 1 and grade 2 for the low group, but no difference at all between grades 2 and 3.

At grades 1 and 2 the correct responses to c→[s] were so low that ability group differences were attenuated. However, by the end of third grade, mean correct scores improved to the point that there was a pronounced ability difference. For c→[k], on the other hand, the overall scores were so high in first grade that little difference in performances across grades occurred, but nevertheless pronounced ability differences were present. The significant grade effect for

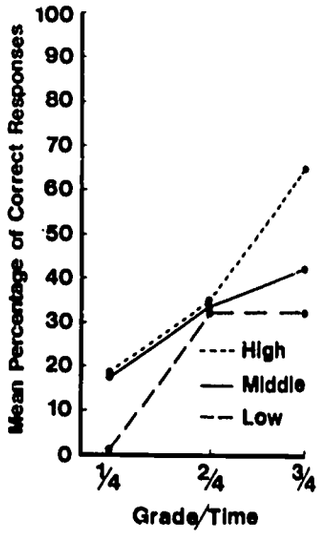

Figure 3 Correct responses to c→[s] patterns by ability group.

the difference between long and short vowel responses is due to an unexplainable drop in correct responses to the a→[æ] pattern in grade 2. In both a patterns, grade 2 performed slightly worse than grade 1. This, however, is probably due to the phonics training introduced this year in grade 1.

Correlation with Reading Comprehension

The correlation of letter-sound ability (total of all four patterns at the last test period) with end-of-the-year Gates-MacGinitie reading comprehension scores was significant at each grade level, but declined from .76 at grade 1 to .63 at grade 3.[3] The correlation of comprehension with letter-sound scores of all 72 subjects at the last test period was .69, which is significant at the .01 level. These correlations, although moderately high, are not unexpected, in that the children who learn to read with phonics programs are heavily dependent upon letter-sound correspondences at the primary levels for comprehending written discourse. As letter-sound ability improves to some minimal level, comprehension practice becomes more readily available, and therefore factors other than letter-sound ability (e.g., use of context) come into play. The decrease in the correlation of comprehension and letter-sound ability from grade to grade supports this notion.

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[3]This decline is not attributable to a range contraction of scores; in fact, the range of comprehension scores increases from grade 1 through grade 3 (2.2; 3.6; 4.4, respectively), while the LSC score ranges are nearly identical (14; 14; 13, respectively).

IV
Discussion

That the long- and short-a curves are similar in shape and reach approximately 80% correct by the end of first grade is an indication of adequate teaching on these patterns. For c, however, the reflection of teaching in the school tested is less than salubrious. The c patterns, which are conditioned by the following letter, are in theory more predictable than the a patterns, which admit a variety of exceptions (e.g., wash, malt, wad, watch).[4] Yet there existed at all three grade levels a strong response bias for [k], regardless of the following letter. Thus, while variant responses to a appeared early in first grade and continued to increase through third grade, an invariant response of [k] to c appeared at the first test period in grade 1 and still had not been overcome by the end of grade 3. This is due, we think, to the overwhelming dominance of c→[k] words in beginning readers.

A separation of the initial and medial c→[s] responses, however, reveals a somewhat more complex situation than a simple response bias for [k]. Response curves for c→[s] before final e and c→[s] in initial position (before e or i) are shown in Figure 4. For final -ce there was a steep and continual increase in correct responses from the first testing period in grade 1 through the final testing period in grade 2, where a peak of almost 82% correct was reached. Grade 3 showed the expected summer decline at testing period 1, followed by a smooth increase back to approximately the peak level of grade 2. The terminal performance for this pattern was higher than

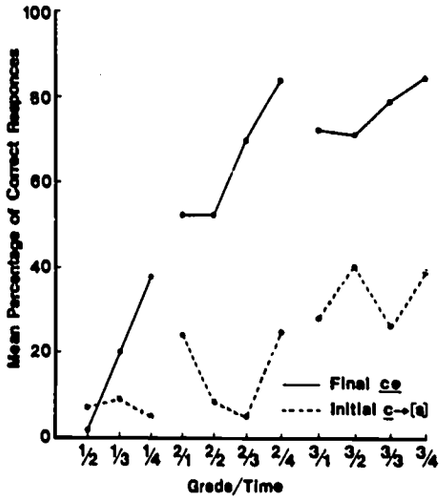

Figure 4 Correct responses to c in [s] environments.

that for either a pattern and only about 6% lower than the corresponding c→[k] performance.

On the other hand, correct responses for c→[s] in initial position showed no increase during grade 1, followed by irregular increases in grades 2 and 3, to a peak performance level of only 40% correct—less than one-half of the final -ce peak performance.

This difference is convincing evidence against a [k] response bias based solely on the letter c. We must at a minimum hypothesize a letter by position interaction, whereby initial c is biased towards [k] and penultimate c is biased toward [s]. On this latter bias, our evidence is incomplete, in that no test items contained penultimate c in an environment where [k] would be anticipated, e.g., final -ct. However, penultimate c→[k] words are rare in primary level reading programs, the major examples generally being act, connect,

[4] c→[ṣ] as in ocean and social is also predictable, but requires consideration of stress placement. No c→[ṣ] patterns were tested in this study, however.

and correct.[5] On the other hand, final -ce words are common beginning early in grade 1.

Thus, our earlier hypothesis concerning a letter-oriented response bias must be modified to include position at least. We suspect that this addition is adequate for describing an initial letter bias, due to the overemphasis which this position generally receives in reading instruction, but are less confident about applying it directly to penultimate c. The possibility that final -ce as in face is treated as a unit cannot be ruled out, and in fact is at present the more attractive hypothesis. This is, nevertheless, still a letter by position interaction, in that final -ce is treated differently from initial ce (e.g., cent).

The process we hypothesize for applying letter-sound correspondences reduces to the following:

1. Identify the spelling units in the word.
2. For each spelling unit, search visual memory for words with that unit in the same position. If it is found, retrieve the most frequently occurring pronunciation.
3. If it is not found, search for the unit or a subset of the unit in any position.

We cannot substantiate all of the assumptions, but we can give some logical argument for each. In step one, the initial task of identifying spelling units is based on evidence gathered by Johnson (1970) and Calfee, Venezky, and Chapman (1969) which showed that beginning readers seldom split units like oo, th, and ch into sequences of single letter units. The position search in step two is based upon arguments just presented. The notion of search of real words as opposed to search of a rule store is a matter of choosing the simpler of two hypotheses. If a word store cannot be searched, then the mechanism for modifying rules with the addition of new real word examples becomes quite complex.

The notion of retrieving the most frequently occurring pronunciation (step two) is a temporization for lack of sufficient data on the relative influences of types and tokens, or on how generalizations (or search procedures) change over time. The type/token notion was supported in a related study, however, where Johnson (1970) found that types were generally more important than tokens in influencing digraph vowel pronunciations.

The secondary search in step three accounts for the relatively high number of [k] responses to final -ce. These require a connection between the various position-oriented correspondences for the same letter and the mechanism presented here appears to be both adequate and simple. This, however, along with several other areas mentioned above requires more extensive experimentation.

Pedagogical Implications

There can be little doubt that whatever rating is given to the teaching of the a pattern in the school tested, the teaching of the c pattern was less successful. An analysis of both the textbook presentation of c and the actual classroom practice reported by the teachers shows that although c→[k] in initial position is introduced early in grade 1 and illustrated with numerous examples, c→[s] in this same position is sequenced considerable later in grade 1 and is often never reached for lack of time. In addition, relatively little emphasis is given to either the c→[s] correspondence or to the words which illustrate it.[6] (Likewise, fewer c→[s] words occur in the beginning reading materials.)

In contrast to this, both long- and short-a correspondences are introduced early in grade 1, and are reinforced frequently. The distinction between the two sounds is pointed out by a variety of mechanisms, including contrastive pairs like can:cane, at:ate, and cap:cape. Similar procedures are needed for teaching c, including continual reinforcement and review. Finally, the poorer readers need more practice in letter-sound translation than they are currently receiving. This is especially true for the a pattern in grade 2 and the c→[s] pattern in grade 3.

[5] In the 20,000 most common words, there are only three patterns—excluding ck and ch—where penultimate c is pronounced [k]: ct (about 120 words), ca (about 20 words, most of which are proper nouns), and co (about 10 words).

[6] In a popular reading series which we examined, the initial c→[k] words represented approximately 94% of all initial c words introduced. (The totals for grades 1, 2, and 3 of initial c→[s] words were 0, 3, and 3, respectively.)

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